PROJECT facts

ADVANCED CLEAN/EFFICIENT
POWER systems

PS011.0697

Department of Energy
Office of Fossil Energy
Federal Energy Technology Center

Optimized Fuel Injector Design for Maximum In-Furnace NO_X Reduction and Minimum Unburned Carbon

Project Description

In-furnace NO_x control techniques that include low NO_x burners and coal reburning are the most cost effective NO_x controls. However, these NO_x control technologies may have a negative impact on carbon utilization by increasing the levels of unburned carbon in coal ash wastes. Recent tests under the Clean Coal Technology Demonstration program indicated that, with low-NO_x burners and advanced overfire air, NO_x emissions were reduced by a 45–55% level and that unburned carbon content in ash increased from 5 to 10%.

This project aims to understand the mechanisms responsible for high unburned carbon-in-ash levels in low-NO_x combustion systems. Applied research and engineering development of low-NO_x burners and fuel injectors for reburning is included. The team of Reaction Engineering International (REI), University of Utah, Brown University, and DB Riley, Inc. will develop fundamental information related to low NO_x burners. The University of Utah will examine two-phase mixing and near-field behavior of burners using a 15-million Btu/hr furnace. Brown University will examine char deactivation and effectiveness of reburning, and REI will develop a comprehensive burner model using the data produced by the University of Utah and Brown University. This work will provide experimental data and computer simulation models for design of low-NO_x burners and coal reburning injectors that maximize NO_x reduction and minimize unburned carbon.

Program Goal

The goal of this work is to maximize NO_x reduction, while minimizing unburned carbon in ash, in combustion systems that use low-NO_x burners and coal reburning. By focusing on heterogeneous reaction chemistry and two-phase mixing of a gas-solid system of coal particles and combustor gas, mechanisms for production/reduction of NO_x and unburned carbon near the burner zone will be investigated.

PRIMARY PROJECT PARTNERS

Reaction Engineering International
Salt Lake City, UT

MAIN SITE

Salt Late City, UT

TOTAL ESTIMATED COST

$2,900,679

COST SHARING

DOE	**$2,110,957**
Non-DOE	**$789,722**

Optimized Fuel Injector Design for Maximum In-Furnace NO_x Reduction and Minimum Unburned Carbon

Project Benefits

For cleaner burning of coal, low-NO_x burners are employed by many electric power producers. Coal represents, by far, the largest fossil energy resource in the U.S. This project is intended to provide the U.S. power industry with an environmentally superior alternatives to current technologies.

Reaction Engineering International and its project team members are world-class experts in coal combustion technology and in-furnace NO_x control. This work will provide the information needed to:

- Reduce in-furnace NO_x formation
- Achieve high carbon burnout, and
- Accurately predict and control the operation of methods to simultaneously achieve low NO_x and high carbon burnout.

This project supports the DOE's clean, efficient, advanced power systems program.

CONTACT POINTS

Michael P. Heap
Reaction Engineering International
Salt Lake City, UT
(801) 328-2002
(801) 364-6977 fax

Lawrence A. Ruth
U.S. Department of Energy
Federal Energy Technology Center
Pittsburgh, PA
(412) 892-4461
(412) 892-5917
ruth@fetc.doe.gov

Project Partners

REACTION ENGINEERING INTERNATIONAL
Salt Lake City, UT
(data analysis and computer modeling)

UNIVERSITY OF UTAH
Salt Lake City, UT
(two-phase mixing and combustion studies)

BROWN UNIVERSITY
Providence, RI
(char reactivity)

DB RILEY, INC.
Worcester, MA
(burner testing)

Cost Profile

(Dollars in Thousands)

	Prior Investment	FY95	FY96	FY97	Future Funds
Department of Energy*	$230.0	$516.3	$2.6	$694.5	$667.5
Private Sector Partners	$90.7	$203.7	$1.0	$252.1	$242.2

* Appropriated Funding

Key Milestones